CLAIMS:

1. A semiconductor device made by providing on a substrate an active region that functions as a portion of an active element,

wherein the active region is configured by layering:

at least one first semiconductor layer which is provided on the substrate, and which functions as a carrier transit region, and

at least one second semiconductor layer which includes a higher concentration of impurities for carriers than the first semiconductor layer, which has a thinner film thickness than the first semiconductor layer, and from which carriers can migrate to the first semiconductor layer due to quantum effects.

2. The semiconductor device according to claim 1, wherein the first and second semiconductor layers are each provided in plurality and are layered in alternation.

3. The semiconductor device according to claim 1 or 2,

wherein the concentration of impurities for carriers in the first semiconductor layer is below 1×10^{17} atoms . cm^{-3}, and

wherein the concentration of impurities for carriers in the second semiconductor layer is at least 10^{17} atoms . cm^{-3}.

4. The semiconductor device according to any of claims 1 to 3, wherein the substrate and the active region are made of one material selected from SiC, GaN, and GaAs.

5. The semiconductor device according to any of claims 1 to 4, wherein the first and second semiconductor layers in the active region are made of the same material.

6. The semiconductor device according to any of claims 1 to 3,

wherein the second semiconductor layer is a SiC layer, and

wherein the thickness of the second semiconductor layer is at least one monolayer and below 20 nm.

7. The semiconductor device according to any of claims 1 to 3,

wherein the first semiconductor layer is a SiC layer, and

wherein the thickness of the first semiconductor layer is at least about 10 nm and at most about 100 nm.

8. The semiconductor device according to any of claims 1 to 7,

wherein the substrate is a semiconductor layer that includes a high concentration of impurities,

wherein the uppermost portion of the active region is made of the first semiconductor layer, and

wherein the semiconductor device further comprises a Schottky electrode providing a Schottky contact with a portion of the upper surface of the first semiconductor layer at the uppermost portion of the active region, and

an ohmic electrode providing an ohmic contact with a portion of the substrate.

9. The semiconductor device according to any of claims 1 to 7, further comprising:

a Schottky electrode providing a Schottky contact with a first lateral face of the first semiconductor layer and of the second semiconductor layer of the active region, and

an electrode that is connected to a second lateral face of the first semiconductor layer and of the second semiconductor layer of the active region, the second lateral face being arranged at a certain spacing from the first lateral face.

10. The semiconductor device according to claim 9, further comprising a doped layer for connecting lead, which is formed by introducing a high concentration of impurities into a region of the active region that is at a certain spacing from the first lateral face of the first semiconductor layer and the second semiconductor layer, and

wherein the electrode is in ohmic contact with the doped layer for connecting lead.

11. The semiconductor device according to any of claims 1 to 7, wherein the uppermost portion of the active region is made of the first semiconductor layer, and

wherein the semiconductor device further comprises:

a Schottky gate electrode, which is in Schottky contact with a portion of the upper surface of the first semiconductor layer at the uppermost portion of the active region, and

source and drain electrodes, which are provided on the active region and sandwich the Schottky gate electrode, and which are connected to the active region.

12. The semiconductor device according to claim 11, further comprising:

two third semiconductor layers, which are provided on the active region and sandwich the Schottky gate electrode, and which include a high concentration of impurities, and

wherein the source and drain electrodes are in ohmic contact with the third semiconductor layers.